

5. Contents of Amendment

(1) The statement of "The invention as stated in claim 1 at the second measuring step." from the 1st line to the 6th line on the 3rd page (the line 18 to the line 26 on the 3rd substitute page (at the 1st Amendment) in English translation edition) in the specification is amended as follows. As a result of this, the 3rd page (the 3rd substitute page (at the 1st Amendment) in English translation edition) is replaced with the 3rd page and 3rd/1 page (the 3rd substitute page in English translation edition) on replacement sheets.

"The invention as stated in claim 1 is a vehicle state analyzing method, comprising: a suspension/chassis setting step for setting an optimum suspension/chassis for a vehicle; a first measuring step for measuring a lateral force in the vehicle by running the vehicle which is set on a road surface as reference under a predetermined condition with using a force sensor which detects input of force from a wheel to a vehicle body, and measuring fluctuation or fluctuation rate of the lateral force; a second measuring step for measuring a lateral force in the vehicle by running the vehicle thereafter on a road surface with using the force sensor, and measuring fluctuation or fluctuation rate of the lateral force; and a comparing and computing step for comparing and computing of the measured value obtained at the first measuring step and the measured value obtained at the second measuring step."

(2) The statement of "With the vehicle state analyzing method as stated in claim 1, the vehicle (the second measuring step)." from the 15th line to the 20th line on the 3rd page (the line 9 to the line 18 on the 4th substitute page (at the 1st Amendment) in English translation edition) in the specification is amended as follows.

"With the vehicle state analyzing method as stated in claim 1, the vehicle which is set with an optimum suspension/chassis state is first run for a certain period of time on the road surface as reference under a predetermined condition, such as the straight forward run, or the like, to measure the lateral force in the vehicle using a force sensor for detecting the inputs of force from the wheels to the vehicle body, and measure the fluctuation or fluctuation rate of the lateral force in the vehicle (the first measuring step). The vehicle may change in state, depending upon the use thereof, thus after having been run or used to some extent, the vehicle is run on a road surface under a predetermined condition in the same manner as at the previous time to measure the lateral force in the vehicle using the force sensor, and measure the fluctuation or fluctuation rate of the lateral force in the vehicle (the second measuring step)."

(3) The statement of "Next, the operation of the vehicle state analyzing system as stated in claim 2 will be described." in the 7th line on the 4th page (the line 8 to the line 9 on the 5th substitute page (at the 1st Amendment) in English translation edition) in the specification is amended as follows. As a result of this, the 3rd page (the 5th and 5th/1 substitute pages (at the 1st Amendment) in English translation edition) is replaced with the 3rd page and 3rd/1 page (the 5th and 5th/1 substitute page in English translation edition) on replacement sheets.

"Next, the operation of the vehicle state analyzing method as stated in claim 2 will be described."

(4) Claim 1 is amended as on the separate sheet.

6. List of Attached Documents

(1) The 3rd, 3rd/1, 4th, and 4th/1 pages (the 3rd, 4th, 5th and 5th/1 substitute pages in English translation edition) of the specification.

(2) The 17th and 18th pages (the 21th, 22th and 23th substitute pages in English translation edition) of the claims

In addition, no art has been available which, when the alignment has been changed due to some factor, such as a time dependent change (a change with passage of time), or the like, automatically adjusts the alignment such that the running stability of the vehicle is not deteriorated.

Further, a method is available which measures the magnitude of a lateral force by use of a platform tester, and adjusts the lateral force to be within the specified tolerance (reference range), but the method will not allow examining the fluctuation of the lateral force to the vehicle when the vehicle normal running.

The purpose of the present invention is to eliminate the drawbacks of the above-mentioned prior art, and to provide a vehicle state analyzing system, a vehicle, and a vehicle state management system which can grasp a problem of the state of a vehicle in normal running, such as the running stability related to the wheel mounting angle which depends on the characteristics of the tire, the time dependent change of the suspension/chassis or the change in adjustment of the suspension, the change in internal pressure of the tire, and the like.

DISCLOSURE OF THE INVENTION

The invention as stated in claim 1 is a vehicle state analyzing method, comprising: a suspension/chassis setting step for setting an optimum suspension/chassis for a vehicle; a first measuring step for measuring a lateral force in the vehicle by running the vehicle which is set on a road surface as reference under a predetermined condition with using a force sensor which detects input of force from a wheel to a vehicle body, and measuring fluctuation or fluctuation rate of the lateral force; a second measuring step for measuring a lateral force in the vehicle by running the vehicle thereafter on a road surface with using the force sensor, and measuring fluctuation or fluctuation rate of the lateral force; and a comparing and computing step for comparing and computing of the measured value obtained at the first measuring step and the measured value obtained at the second measuring step.

Next, the operation the vehicle state analyzing method as stated in claim 1 will be

described.

The running stability of a vehicle is determined by balance of fluctuation of force inputted to the suspension/chassis through the tire.

However, these fluctuation of force depends upon the distribution of the load caused by the state of the suspension/chassis of the vehicle and the vehicle body, the tolerance (error) for mounting position of the suspension, mounting of the wheel, construction of the tire, and the dispersion as an industrial product.

Therefore, the running stability can be managed by monitoring and analyzing, with the input from the road surface which is optimal for each vehicle as being a reference value, the disparate from the current situation.

With the vehicle state analyzing method as stated in claim 1, the vehicle which is set with an optimum suspension/chassis state is first run for a certain period of time on the road surface as reference under a predetermined condition, such as the straight forward run, or the like, to measure the lateral force in the vehicle using a force sensor for detecting the inputs of force from the wheels to the vehicle body, and measure the fluctuation or fluctuation rate of the lateral force in the vehicle (the first measuring step). The vehicle may change in state, depending upon the use thereof, thus after having been run or used to some extent, the vehicle is run on a road surface under a predetermined condition in the same manner as at the previous time to measure the lateral force in the vehicle using the force sensor, and measure the fluctuation or fluctuation rate of the lateral force in the vehicle (the second measuring step).

Then, by comparing and computing the measured value obtained at the first measuring step and the measured value obtained at the second measuring step (the comparing and computing step), the state of the vehicle can be analyzed.

For example, when the toe angle, the camber angle, the internal pressure for the tire, or the like, is changed in the vehicle, the inputs of forces from the wheels to the vehicle body are changed.

Therefore, according to this vehicle state analyzing method, a change from an optimum suspension/chassis state that is caused by a change in state of the vehicle,

such as that in toe angle, camber angle, internal pressure for tire, or the like, can be grasped.

As described above, according to the vehicle state analyzing method as stated in claim 1, an effect that the problem of the running stability related to the wheel mounting angle which depends on the characteristics of the tire, the time dependent change of the suspension/chassis or the adjustment change of the suspension, the change in internal pressure of the tire, and the like can be grasped, is obtained.

In the invention as stated in claim 2 according to the vehicle state analyzing method of claim 1, the fluctuation or the fluctuation rate of the lateral force is measured when normal running of the vehicle.

Next, the operation of the vehicle state analyzing method as stated in claim 2 will be described.

With the vehicle state analyzing method as stated in claim 2, the fluctuation or fluctuation rate of the lateral force is measured in normal running of the vehicle. Therefore, the state of the vehicle in normal running can be known.

Herein, the phrase "when normal running" refers to a case where the user (the driver) runs on a general normal road surface with a vehicle, and different for a case in which where the vehicle runs on a test road surface on a platform tester, or the like.

The invention as stated in claim 3 is a vehicle state analyzing system for analyzing state of a vehicle having wheels, comprising: measuring means, provided in the vehicle, for measuring fluctuation or fluctuation rate of lateral force inputted to the vehicle through the wheel when the vehicle is run on a road surface; and computing means for computing time dependent change of data measured by the measuring means.

Next, the operation of the vehicle state analyzing system as stated in claim 3 will be described.

With the vehicle state analyzing system as stated in claim 3, the measuring means provided in the vehicle measures the fluctuation or fluctuation rate of the lateral force inputted to the vehicle through the wheel, and the computing means computes the time

dependent change of the data measured by the measuring means.

The invention as stated in claim 4 is a vehicle state analyzing system for analyzing state of a vehicle having wheels, comprising: a force sensor for detecting input of force from the wheel to the vehicle body; first memory means for storing information related to output of the force sensor when the vehicle which is set to be an optimum alignment state is run on a road surface as reference under a predetermined condition as a reference value; second memory means for storing information related to output of the force sensor when normal

What is claimed is:

1. (Amended) A vehicle state analyzing method, comprising:
 - a suspension/chassis setting step for setting an optimum suspension/chassis for a vehicle;
 - a first measuring step for measuring a lateral force in the vehicle by running the vehicle which is set on a road surface as reference under a predetermined condition with using a force sensor which detects input of force from a wheel to a vehicle body, and measuring fluctuation or fluctuation rate of the lateral force;
 - a second measuring step for measuring a lateral force in the vehicle by running the vehicle thereafter on a road surface with using the force sensor, and measuring fluctuation or fluctuation rate of the lateral force; and
 - a comparing and computing step for comparing and computing of the measured value obtained at the first measuring step and the measured value obtained at the second measuring step.
2. The vehicle state analyzing method of claim 1, wherein the fluctuation or the fluctuation rate of the lateral force is measured when normal running of the vehicle.
3. A vehicle state analyzing system for analyzing state of a vehicle having wheels, comprising:
 - measuring means, provided in the vehicle, for measuring fluctuation or fluctuation rate of lateral force inputted to the vehicle through the wheel when the vehicle is run on a road surface; and
 - computing means for computing time dependent change of data measured by the measuring means.
4. A vehicle state analyzing system for analyzing state of a vehicle having wheels, comprising:

a force sensor for detecting input of force from the wheel to the vehicle body;

first memory means for storing information related to output of the force sensor when the vehicle which is set to be an optimum alignment state is run on a road surface as reference under a predetermined condition as a reference value;

second memory means for storing information related to output of the force sensor when normal running of the vehicle;

analyzing computation means for monitoring the output of the force sensor, and, on the basis of at least the information stored in the first memory means and the information stored in the second memory means, for analyzing the state of the vehicle; and

information output means for outputting at least one of the information stored in the first memory means, the information stored in the second memory means, and the result of analysis obtained by the analyzing computation means.

5. The vehicle state analyzing system of claim 4, wherein the force sensor is provided in the vehicle,

the first memory means, the second memory means, the analyzing computation means, and the information output means are provided outside the vehicle.

6.

7. A vehicle on which the vehicle state analyzing system of claim 4 is mounted.

8. A vehicle comprising:

the vehicle state analyzing system of claim 4; and

display means for displaying the state of the vehicle obtained by the analyzing computation means.

9. A vehicle comprising:

the vehicle state analyzing system of claim 4; and
adjustment means for automatically adjusting alignment of a suspension on the basis of the state of the vehicle analyzed by the analyzing computation means.

10. A vehicle state management system, comprising:
the vehicle state analyzing system of claim 4; and
a vehicle testing apparatus having a road surface for running which causes the wheels to be rotated, detecting the state of the vehicle from outside, and being capable of storing the state of the vehicle detected from the outside and the state of the vehicle analyzed by the vehicle state analyzing system.